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(54) ADHESIVE ARTICLES

(71) We, EVODE LIMITED, a British Company, of Common Road, Stafford, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of adhesively joining two surfaces and to an adhesive transfer tape in which a pressure-sensitive adhesive is presented in a manner convenient for use in such a method.

Pressure-sensitive adhesives have the advantage that they do not require activation by heat or solvent or mixing of reaction ingredients prior to use and a satisfactory bond for many purposes is achieved immediately on contacting the adhesive under light, unsustained pressure with the surfaces to be joined.

Conventionally, pressure-sensitive adhesives are applied in the form of a solution or emulsion to one of the surfaces to be bonded, e.g. a floor tile or decorative laminate, and the liquid phase of the adhesive must be allowed to evaporate before the tile or laminate is pressed into contact with the support substrate. Inexperienced users especially, often find it a difficult and messy operation to apply the adhesive and frequently use too much adhesive with the result that in applying bonding pressure to the surfaces to be joined, excess adhesive is squeezed out and mars the appearance of the bond.

According to the present invention there is provided a method of adhesively joining two surfaces together in which a pressure-sensitive adhesive is transferred to one of said surfaces from a carrier sheet having a release surface, as hereinafter defined, on both sides of the sheet the adhesive being supported as an array of discrete, mutually separate areas on one side of the sheet, said method comprising bringing said one surface into contact with said array under light pressure and removing said carrier sheet, whereby adhesive is transferred to said one surface solely in the region delineated by mutual contact between the adhesive and said one surface and pressing a second surface firmly into contact with the exposed adhesive areas so as to bond said two surfaces together.

The term "release surface" has its familiar meaning in the adhesive art, namely a surface for which the adhesive in question has little affinity and therefore forms a bond with such surface of very low strength. Normally release surfaces are obtained by coating a substrate with the appropriate amount of an agent exhibiting the desired low degree of affinity for the adhesives. Silicones are commonly used for this purpose because of their low degree of affinity for a wide range of materials. Alternatively plastic films having an inherently low degree of affinity for the adhesives, e.g. polyethylene may constitute the release surface.

Normally it is only necessary to apply the surface to which the adhesive is to be transferred, e.g. a tile or decorative laminate, under light hand pressure to the adhesive on the carrier sheet.

The invention includes an adhesive transfer tape for use in the method described above which comprises a carrier sheet having a release surface, as hereinbefore defined, on both sides of said sheet and a pressure-sensitive adhesive supported on said release surface on a first side of the sheet as an array of discrete, mutually separate areas disposed over said release surface, said adhesive being transferable to a second surface for which the adhesive has a greater affinity than for the release surface by application under light pressure to the second surface and removal of the carrier sheet, said first side of the carrier sheet having a greater affinity for the adhesive than the other side of the sheet so that the type can be uncoiled from a roll without inadvertent transfer from said first side to the other side of the sheet.

Transfer tapes in accordance with the invention will normally take the form of a carrier sheet having two release surfaces, the surface which has the greater affinity bearing an array of discrete discs or buttons of pressure-sensitive material, although other shapes are possible e.g. rectangles, trapeziums or ribbons. The adhesive areas need not be of uniform size and shape although this is generally more convenient.

Transfer of adhesive to a surface to be bonded is a simple matter in accordance with the invention. Thus if one wishes to bond for example a tile to a wall, the rear surface of the tile is pressed lightly on the adhesive buttons on the carrier sheet. When the tile is lifted away from the sheet, the buttons of adhesive release from the carrier sheet in the area covered by the tile, leaving adhesive in other areas remaining on the carrier sheet. The tile, bearing the correct amount of adhesive distributed over its surface, is then pressed against the wall surface and a good bond having a clean appearance is obtained. Additional tiles can be coated with adhesive in a similar fashion by pressing them on other areas of the carrier sheet so that ultimately all the adhesive on the carrier sheet is used. As can be appreciated intricately shaped articles can be easily and quickly coated accurately with the correct amount of adhesive, without any skill being required.

It should be noted that if the adhesive is not arranged as an array of discrete areas on the carrier sheet it is not possible to transfer the adhesive cleanly from the release surface because the cohesiveness of the adhesive causes a large amount of adhesive outside the area of the tile to strip from the carrier sheet.

Naturally the pattern of the array and the size and thickness of the button of adhesive will depend on the intended end use. As an example, a suitable pattern for joining sheets of paper might consist of discs of adhesive about 2 mm. in diameter and about .025 mm. thick spaced at 5 mm. centres uniformly distributed over the carrier sheet. For heavier duty applications such as bonding ceramic wall tiles, it may be necessary to use thicker adhesive areas deposited in a higher density on the carrier sheet although preferably not more than a minor proportion of the area of the carrier sheet is coated with adhesive.

Because of the release coating on the opposite side of the tape to that bearing the adhesive, the tapes in accordance with the invention do not require to be coiled with an interleaving protective sheet having release properties for the purposes of packing, storage and transport. In order to ensure that the adhesive, prior to use, remains on the side of the carrier sheet on which it has been deposited the side bearing the adhesive areas should have a lower release characteristic than the opposite side. This can be achieved for example, by coating the reverse side of the carrier sheet with a larger quantity of release agent, such as silicone material, than the side to be coated with the pressure-sensitive adhesive. Alternatively a polymer film (e.g. polyethylene) having inherent release characteristics (or a polymer/paper laminate) can be coated with a release agent such as silicone preparation on one surface in order to present a carrier sheet having differential release properties. It has been found in practice that by using a carrier sheet having differential release characteristics in the proportion of at least 2.5 to 1 is very satisfactory in use; the side bearing the adhesive has the relatively higher affinity towards the adhesive. This ratio is calculated by measuring the adhesion of a standard portion of pressure-sensitive adhesive to each side of the carrier sheet.

The adhesive may be applied to the backing sheet by a variety of techniques including the following:

1. Spraying the adhesive with or without a stencil.
2. Roller coating utilising a stencil.
3. Roller coating using a gravure or etched roller.
4. Roller coating using the raised or embossed roller.
5. Screen printing.
6. The use of pressure feed nozzles distributing discrete blobs of adhesive on the carrier sheet.

Currently we prefer to use a modified screen printing process for producing the transfer tape which comprises guiding a carrier sheet around a portion of the circumference of a rotating, perforated drum, introducing adhesive into the interior of the drum in the form of a viscous solution or emulsion and regulating the emission of adhesive through the perforations and the deposition of adhesive onto the carrier sheet by means of a squeegee which contacts the inner surface of the drum. This method is described in more detail hereinafter.

The pressure-sensitive adhesive should be of a character which is capable of maintaining its physical shape under normal conditions likely to be encountered during handling and storage. Pressure sensitive adhesives which slump or flow are unsatisfactory for use in accordance with the invention.

Preferred pressure sensitive adhesive materials are those based on acrylic or methacrylic monomers. For example, satisfactory adhesives may be prepared from acrylic ester monomers having the general formula:

$$CH_2=CHCOOR$$

where R is an alkyl group of general formula

$C_nH_{(2n+1)}$ and n is an integer from 1 to 12. Pressure sensitive homopolymers may be prepared from monomers in which n is 4 to 12, especially 4 to 8.

Pressure sensitive copolymers of these esters may be prepared in which n has the value 1 to 12.

Suitable pressure sensitive adhesive may also be prepared from homopolymers or copolymers of methacrylic esters of the general formula:

$$CH_2=\underset{\displaystyle CH_3}{\overset{|}{C}}COOR$$

wherein R is an alkyl group having the formula $C_nH_{(2n+1)}$ and n is 4 to 12.

Copolymers of acrylic esters with methacrylic esters are also capable of providing pressure sensitive adhesives useful in the present invention. Furthermore interpolymers of acrylic and/or methacrylic esters may be prepared using three or more monomers to produce pressure sensitive interpolymers. Desirably the pressure sensitive acrylic or methacrylic ester polymers contain not more than 20% of comonomer and preferably the comonomer is used in an amount of from .1 to 10% of the polymer weight. The comonomer is added to modify the properties of the polymer e.g. to facilitate cross-linking of the resultant mass and thereby improve its the adhesive to slump. The following comonomers are suitable for copolymerising with acrylic or methacrylic esters; acrylic acid, methacrylic acid, acrylonitrile, glycidyl methacrylate, hydroxy ethyl methacrylate, hydroxy propyl methacrylate, ethylene glycol dimethacrylate, propylene glycol dimethacrylate, trimethylol propane trimethacrylate, butyl amino ethyl methacrylate, 1,4 - butane - diol dimethacrylate, acrylamide, methacrylamide, n-vinyl pyrrolidone, styrene, vinyl toluene, vinyl laurate, vinyl caprate and vinyl acetate. The polymers may be produced by polymerising the monomers in organic solvent such as ethyl acetate, hexane and toluene or in mixtures of organic solvents by well known techniques of solvent polymerisation. Alternatively polymerisation may be carried out in emulsion using suitable surfactants and the usual redox catalysts and modifiers. As will be appreciated the physical properties and tackiness of the resultant polymers are dependent in measure upon the molecular weight of the polymer. The extent of polymerisation must therefore be controlled so that the resultant polymer has sufficient cohesiveness and integrity to retain its physical shape when cast onto a support or carrier and yet polymerisation is not so advanced that the polymer does not exhibit surface tack.

The properties of the resultant polymer may be modified to enhance desirable characteristics, e.g. to increase the viscosity or increase surface tack.

Other types of pressure sensitive adhesives may be used in the production of adhesive articles in accordance with the invention including rubber/resin blends in which the rubber is natural or synthetic in origin and is blended together with natural or synthetic resins to yield a tack material. Suitable adhesives may also be based on polyvinyl ether resins.

The pressure sensitive adhesive is conveniently deposited on the carrier sheet from solution in an organic solvent or from an emulsion and subsequently removing the liquid phase by evaporation. However, it is within the scope of the invention to deposit the adhesive in the form of a hot melt which, on cooling, retains a sufficient degree of flexibility and surface tackiness.

It is possible and advantageous for certain applications to deposit two or more types of pressure sensitive material on a single carrier sheet. Thus one type of adhesive may be formulated for sticking paper to paper while another is formulated for sticking thermoplastic tiles to wood or other surfaces. By pressing the desired article to be bonded in contact with the carrier sheet, both types of pressure sensitive adhesives are transferred but, by interspersing the different types of adhesive uniformly over the sheet, sufficient adhesive of the desired type is transferred to the article to be bonded.

The preparation of an adhesive article in accordance with the invention will be appreciated more readily from the accompanying drawing in which:

Figure 1 is a side elevation of a diagrammatic view of apparatus for depositing adhesive onto the carrier sheet, and

Figure 2 is a plan view of the transfer tape.

Referring to Figure 1, a nickel plated drum approximately 12 inches in diameter is arranged to rotate in the direction indicated by the arrow. The drum 1 has a perforated cylindrical wall, the perforations being sized and arranged appropriately for the size and distribution of adhesive areas desired to deposit on the carrier sheet. A carrier sheet 2 is fed into contact with the drum 1 and is guided around the portion of the circumference of drum 1 by means of guide rollers 3 and 4. Pressure sensitive adhesive as a solution or emulsion is emitted from a tube 5 which extends axially of the drum 1 and has orifices enabling the adhesive to be deposited as a curtain on the internal wall of the drum 1. Thus adhesive emitted from tube 5 is carried with the rotation of the drum 1 towards a squeegee 6 which regulates the amount of adhesive which is forced out of the drum 1 through perforations in its walls is deposited in discrete areas on the carrier

sheet. The carrier sheet 2 is then conveyed through a tunnel drying oven in which the liquid phase of the adhesive is removed.

Figure 2 is a plan view of the carrier sheet after coating with the adhesive. As will be seen the carrier sheet, which comprises a thick paper sheet coated on both surfaces with silicone release agent, bears on one of its surfaces an array of circular areas of pressure sensitive adhesive 7.

The invention will be further illustrated with reference to the accompanying examples.

Example I

98 parts by weight of an aqueous emulsion containing a copolymer of 2-ethyl hexyl acrylate and acrylonitrile at 50% solids content were mixed with 2 parts by weight of an aqueous polyacrylic acid emulsion of 17% solids content. The copolymer emulsion is obtainable from Harco Limited of Harlow, Essex, under the registered trade mark Revertex 2030 while the polyacrylic acid emulsion is obtainable from the same company under the registered trade mark Revacryl A191. The mixed emulsions were adjusted to pH 7.5 with .880 ammonia and deposited by a screen printing technique onto a carrier sheet comprising a laminate of paper and polyethylene as described above in connection with Fig. 2. The adhesive was cast onto the polyethylene side, the paper having been coated with a silicone release material so that it possessed release characteristics superior to the polyethylene. The adhesive was deposited as discs 2 mm. in diameter at 5 mm. centres and 0.0125 mm. thick. The resulting coated carrier was heated to drive off the water and the resulting product was cut into small sheets and stacked in layers.

Example II

20 parts by weight of a butadiene-styrene rubber (Polysar S.1006 (Registered Trade Mark) obtainable from Polysar (U.K.) Limited) were dissolved in 60 parts by weight of hydrocarbon solvent (boiling range 140° to 162°C.) (SBP 60 obtainable from Esso Chemicals Limited) together with 20 parts by weight of a rosin ester gum (Stabelite ester 10, obtainable from Hercules Powder Company). The resulting solution was deposited by means of the apparatus shown in Figure 1 onto the polyethylene/paper laminate described in Example I. The adhesive was deposited as discs 2.5 mm. in diameter, at 6 mm. centres and 0.048 mm. thick.

Example III

A blend of polyvinyl ethers comprising 10 parts by weight of Lutanol J. 60 and 20 parts by weight of Lutanol 1CK 125 (both available from BASF (U.K.) Ltd. "Lutanol" is a Registered Trade Mark). were dissolved in 70 parts by weight of the same hydrocarbon solvent used in Example II. The resulting solution was deposited via a gravure roller onto the polyethylene/paper laminate described in Example I as discs 3 mm. in diameter, at 7 mm. centres and 0.25 mm. thick. The coated laminate was passed through a drying tunnel to demove the solvent whereupon the product was formed into a roll.

WHAT WE CLAIM IS:—

1. A method of adhesively joining two surfaces together in which a pressure-sensitive adhesive is transferred to one of said surfaces from a carrier sheet having a release surface, as hereinbefore defined on both sides of the sheet, the adhesive being supported as an array of discrete, mutually separate areas on one side of the sheet, said method comprising bringing said one surface into contact with said array under light pressure and removing said carrier sheet, whereby adhesive is transferred to said one surface solely in the region delineated by mutual contact between the adhesive and said one surface and pressing a second surface firmly into contact with the exposed adhesive area so as to bond said two surfaces together.

2. An adhesive transfer tape for use in the method claimed in claim 1 which comprises a carrier sheet having a release surface, as hereinbefore defined, on both sides of said sheet, and a pressure-sensitive adhesive supported on said release surface on a first side of the sheet as an array of discrete mutually separate areas disposed over said release surface, said adhesive being transferable to a second surface for which the adhesive has a greater affinity than for the release surface by application under light pressure to the second surface and removal of the carrier sheet, said first side of the carrier sheet having a greater affinity for the adhesive than the other side of the sheet so that the tape can be uncoiled from a roll without inadvertent transfer from said first side to the other side of the sheet.

3. An adhesive transfer tape for use in the method claimed in claim 1 which comprises a carrier sheet having a release surface, as hereinbefore defined, on both sides of said sheet and a pressure-sensitive adhesive supported on the release surface on a first side of the sheet as an array of discrete, mutually separate areas disposed over the release surface, said adhesive comprising a polymer of an acrylic or methacrylic ester and said adhesive being transferable to a further surface for which the adhesive has a greater affinity than for the release surface by application under light pressure to the further surface and removal of the carrier sheet, said first side of the carrier sheet having a geater affinity for the adhesive than the other side of the sheet so that the tape can be uncoiled from a roll

without inadvertent transfer from said first side to the other side of the sheet.

4. A tape according to claim 3 in which the adhesive is applied to the carrier sheet as an emulsion by a screen printing technique and thereafter dried to remove the continuous phase.

5. A tape according to any one of claims 2 to 4 in which the adhesive is disposed on said carrier sheet as an array of discs or button-shaped areas.

6. A tape acording to any one of claims 2 to 5 in which the adhesive is disposed on said carrier sheet in a density such that a minor proportion of the area of the carrier sheet is coated with adhesive.

7. A tape according to any one of claims 2 to 6 in which the ratio of the strength of the bond of the adhesive to said first side of the carrier sheet to the strength of the bond to the other side is at least 2.5 : 1.

8. A process for producing a transfer tape as claimed in any one of claims 2 to 7 which comprises guiding a carrier sheet around a portion of the circumference of a rotating perforated drum, introducing adhesive into the interior of the drum in the form of a viscous solution or emulsion and regulating the emission of adhesive through the perforations and the deposition of adhesive onto the carrier sheet by means of a squeegee which contacts the inner surface of the drum.

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1 420 743
1 SHEET

COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale.

Fig. 1.

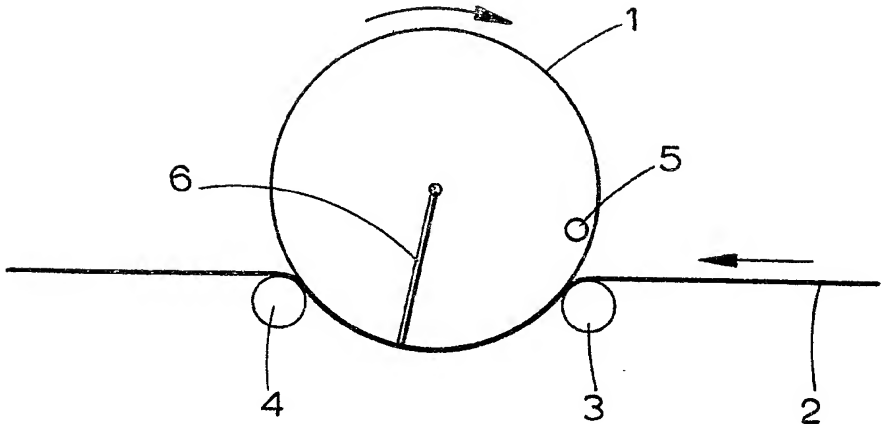

Fig. 2.